FLOW CHART TO EVALUATE WET MICROBURST AND LARGE HAIL POTENTIAL FROM PULSE OR MULTICELLULAR THUNDERSTORMS

TED FUNK
SOO, WFO Louisville

Consider these parameters to help make warning decisions for wet microburst and large hail producing pulse or multicellular storms. In order to issue timely warnings, there may not be time to evaluate all radar parameters below. Thus, always examine the environment first, then enter the flow chart at any point to assess pertinent critical variables. Note: Critical values given are approximate and may vary geographically and from case to case. Note: SPS = Severe Pulse Storm.

ENVIRONMENTAL PARAMETERS

Instability
*Is LI < -4 and CAPE > 2500 (approx.)?
*Does theta-e decrease w/ hgt >16-20 K?
*Are lapse rates in 0-2 km layer nearly dry adiabatic (> 6 K per km)?

YES ►►►

Low-Level Moisture
*Are high values of low-level moisture present (e.g., PW > 1.3; 850 T_d > 12 C; approx.)?

YES ►►►

Evaporative Cooling
*Is dry/unsaturated/low theta-e air present aloft (~700-500 mb, i.e., T_d depression values > 8 C; approx.)? If so, then dry air entrainment will cause evaporative cooling that could significantly enhance downdraft.

►**YES**

NO ►► *Limits updraft strength & large hail potnl; strong wind potnl still present.*

NO ►► *Lower SPS potnl but still possible.* ◄◄ **NO**

Vertical Wind Shear
*Does vertical wind shear exist in environment? If so, then updraft rotation, S-R flow aloft, and deviant storm motion more likely to enhance large hail potnl. Stronger/deeper shear best.

YES ◄◄◄

Height of Freezing Level / Wet Bulb Zero
*On a sounding, is freezing level < 13000 ft?
*Is WBZ > 6000 and < 11000 ft?
If so, then hail more likely due to a shallower warm cloud layer than outside this range.

YES ◄◄◄

*All **YES** answers: Environment very conducive to severe pulse or multicell storms with microbursts and/or large hail.*

NO ►► *Large hail less likely; microburst still possible, especially if YES answer to above parameters.* ◄◄ **NO**

REFLECTIVITY DATA

Boundary Intersections/Cell Mergers
*Is the storm(s) the result of a boundary intersection or cell merger from earlier storms? If so, this may enhance updraft speed and microburst potential.

YES ►►►

NO *SPS still possible; consider other variables.*

Reflectivity Data
*Did the storm's high reflectivity core initially form at a higher altitude than neighboring storms (indicates a strong updraft)?

Usually higher SPS potnl.

NO *Lower SPS potnl but still possible; consider other variables.*

Reflectivity Distribution
*Does Comp Refl, LRM Mid (low tops), and/or LRM High (higher tops) show dBZ values > 55 while low-level (0.5 deg) values are lower? If yes, then max reflectivity core is suspended aloft. Is the suspended core > 50 dBZ vertically deep?

UNK
YES ►►►

Higher SPS potnl; monitor closely for possible wrng.

NO *Lower SPS potnl or pulse occurring or already occurred.*

►**YES** *High SPS potnl if envir. favorable; if so, strongly consider wrng.*

Reflectivity Data
*Assuming other parameters suggest a SPS, choose character of storm's max reflectivity core: **a)** already descended, **b)** still aloft, **c)** descending rapidly.

ANSWER:
a) Descended: SVR threat past.
b) Aloft: issue wrng now for lead time.
c) Descending rapidly: SVR threat imminent; issue wrng at once.

YES ◄◄◄

Higher SPS potnl; if envir. favorable, consider wrng.

Reflectivity vs. Height of Freezing Level
*Does the top of the 50 dBZ core approach or exceed 20000 ft above freezing level? If so, then precipitation loading and melting of ice should enhance the downdraft.

YES ◄◄◄

NO *Slightly lower SPS potnl but still possible; consider other variables.*

Reflectivity Data
*Are any reflectivity values > 65 dBZ present aloft in the storm near or above the freezing level?

High SPS potnl if envir. favorable; if so, issue wrng.

NO *SPS still possible; consider other variables.*

STORM-RELATIVE VELOCITY (SRM) DATA

Mid-Altitude Radial Convergence
*Is strong, deep MARC present in SRM data (V_{in} + V_{out}) > 50 kts from ~10000-20000 ft? (Viewing angle may prevent proper assessment of MARC).

YES ►►►

NO *SPS still possible, especially if bad viewing angle; consider other variables.*

Updraft Rotation
*Is mid-altitude rotation present in storm (indicates strong updraft and possible deviant motion to promote large hail production at surface)?

High SPS potnl given main core aloft and dry mid-lvl air; issue wrng.

NO *SPS still possible; consider other variables.*

Storm-Top Divergence
*Is strong storm-top divergence present in SRM data? Values (V_{out} + V_{in}) > 75 kts associated with hail > 3/4 inch in diameter.

YES ►►►

Higher SPS potnl; if reflectivity variables favorable, issue wrng.

NO *SPS still possible; consider other variables.*

►**YES** *Higher SPS potnl but need to consider reflectivity variables.*

OTHER PARAMETERS

►►►►► **YES** ▼◄◄◄◄◄◄◄◄◄◄

High SPS potnl if envir. is favorable:
a) Issue wrng for some/minimal lead time.
b) Issue wrng at once as SVR threat is imminent or occurring; otherwise, too late for wrng.

Radar Algorithms/SCAN
*Using Cell Trends and/or Hail overlay, **a)** is the Prob. of Svr Hail (POSH) increasing and > 80% AND Max Est. Hail Size (MEHS) > 1.5, OR **b)** were POSH/MEHS very high but in last 1-2 scans are decreasing rapidly indicating possible descending hail core below the freezing level?

NO *Lower SPS potnl, but still monitor storm for changing trends, especially if POSH is < 80% but increasing.*

YES ◄◄◄◄

High SPS potnl; given favorable reflectivity parameters, issue wrng.

VIL Density
*Are VIL Density values > 3.8-4.0? VIL Density = VIL ÷ Echo Top.

NO *Large hail threat lower, especially if < 3.5 but not impossible; watch trends; microburst still possible.*